

SPOT APPLICATION OF DIAMMONIUM PHOSPHATE AND POULTRY LITTER AT ESTABLISHMENT IN AN OLD-FIELD PLANTED LOBLOLLY PINE PLANTATION

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Abstract—A study area was installed in the Coastal Plain (Quitman County) of Georgia to determine the benefits of surface microsite application of diammonium phosphate (DAP) and poultry litter to planted loblolly pine (*Pinus taeda* L.) seedlings on an old-field site. Soils were Bonneau and Orangeburg. Experimental design was complete block with 3 replications per treatment. Treatments were: (1) control = no treatment, (2) spot surface application of DAP (4.6×10^{-3} pounds per square foot) and (3) poultry litter (6.9×10^{-2} pounds per square foot), (4) banded herbicide only, (5) DAP+herbicide and (6) poultry litter+herbicide. Loblolly pine groundline diameter (GLD), total height, and soil pH, P, K, Ca, Mg, Cu, Zn, and Mn at time of application were not significantly different. Two-year GLD, total height, and volume index ($GLD^2 \times \text{height}$) for the three treatments with an herbicide component were significantly larger than the three treatments without an herbicide component. Two-year measurement parameter (GLD, total height, and volume index) results illustrate that there were no statistically significant benefits to adding DAP or poultry litter alone to the microsite around each seedling on this relatively fertile old-field site.

INTRODUCTION

Georgia's forest and poultry industries are two of the largest industries in the State, contributing an estimated 26 billion dollars to the annual economy and directly employing 175,000 workers (GASS 1998). Diammonium phosphate (DAP) is a common fertilizer used for pine establishment to provide N and P needs. Poultry litter can be utilized as an alternative to DAP during pine establishment. Many nonindustrial private forest landowners (NIPFLs) are interested in enhancing early growth of planted southern pines on old-field sites with the use of herbicides, inorganic fertilizers, and animal manures. Some NIPFLs have farm labor that can spot apply various fertilizer materials around each seedling. The objective of this study was to determine the benefits of a surface microsite (4 square feet) application of DAP and poultry litter in conjunction with herbicide to planted loblolly pine (*Pinus taeda* L.) seedlings on an old-field site.

METHODS

The study area was located in Quitman County, GA, on a relatively fertile former peanut field planted to a loblolly pine plantation in December 1999. The soils present on this old-field were Bonneau (Arenic Paleudults) and Orangeburg (Typic Kandiudults). Experimental design was complete block with three replications of six treatments. Treatments included (1) control or no treatment, (2) fertilization with DAP on a 4-square-foot area around each seedling at a rate of 4.6×10^{-3} pounds per square foot (equal to a broadcast rate of 200 pounds DAP per acre), (3) fertilization with poultry litter on a 4-square-foot area around each seedling at a rate of 6.9×10^{-2} pounds per square foot (equal to a broadcast rate of 1.5 tons per acre), (4) banded (4 foot) herbicide application of Oust (3 ounces acre per acre) and Atrazine (5 pints per acre), (5) DAP application in conjunction with herbicide, and (6) poultry

litter application in conjunction with herbicide. The per-square-foot spot application level of DAP and poultry litter around each seedling was equivalent to the recommended DAP (200 pounds per acre, NCSUFNC 1998) and poultry litter (1.5 tons per acre, Dickens and others 2003) broadcast rate at planting for loblolly pine.

Individual plots consisted of 2 rows of 20 living seedlings at time of treatments. Two rows of untreated buffer seedlings were between each plot. Seedlings were measured each winter (survival, groundline diameter, and total height) and soil (0 to 6 inches) and foliage samples were collected. Data were subjected to a one-way analysis of variance, and all statistical tests were conducted at the $\alpha = 0.05$ significance level.

Poultry litter (table 1) and DAP were applied using a 5-gallon plastic bucket and calibrated cup on 5 and 10 April 2000, respectively. The herbicides were band applied by tractor-mounted tank sprayer and band applicator 15 May 2000.

RESULTS

Soil (table 2) and foliar (table 3) nutrient levels were generally above the minimum guidelines range for loblolly pine (Allen 1987, Pritchett and Comerford 1983, Wells and others 1973) 1 and 2 years after treatment (YAT) across the treatments. There were no treatment significant differences for P, K, Ca, Mg, Zn, or Mn in the surface soil or in foliar N, P, K, Ca, or Mg concentration 1 or 2 YAT.

First- and second-year seedling survival between treatments was not significantly different between treatments. Two-year survival ranged from 77 percent (poultry litter) to 92 percent (DAP). Two-year GLD and total height for those treatments with an herbicide component (poultry litter + herbicide, DAP + herbicide, and herbicide alone) were

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Table 1—Poultry (stacked broiler litter) litter characteristics and application level from a 1.5 tons per acre equivalent spot application to an old-field loblolly pine plantation at stand establishment in Quitman County, GA

Component	Concentration		Application level	
	<i>percent</i>	<i>pounds per acre</i>	<i>pounds per seedling (4 square feet)</i>	
Total-N	4.25	127.50	0.0117	
NH ₄ -N	0.37	11.22	0.0010	
Organic-N	3.83	114.90	0.0106	
available-N	2.08	62.40	0.0057	
P ₂ O ₅	4.76	142.95	0.0131	
K ₂ O	2.93	87.90	0.0081	
Ca	2.72	81.60	0.0075	
Mg	0.48	14.43	0.0013	
S	0.52	15.75	0.0014	
Cu	0.04	2.21	0.0002	
Zn	0.04	1.05	0.0001	

Available-N = 60 percent of organic-N and ammonium-N is estimated to plant available when surface applied in the first growing season.

Table 2—Soil nutrient status prior to treatment (2000) and 2 years after treatment (2002) in an old-field planted loblolly pine stand located in Quitman County, GA

Treatment	Phosphorus		Potassium		Calcium		Magnesium		Zinc		Manganese		pH	
	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002
<i>----- pounds per acre -----</i>														
P	45	40	89	68	692	524	33	38	2.7	2.0	27	27	6.3	6.3
P+H	45	43	81	68	659	566	30	30	2.0	2.0	27	33	6.4	6.3
C	55	43	96	75	600	436	30	35	2.7	2.0	28	31	6.2	6.3
H	56	48	85	67	516	392	32	32	2.7	2.3	25	32	6.2	6.2
DAP	51	44	101	74	736	475	38	35	2.7	2.0	27	30	6.3	6.4
DAP+H	41	38	91	56	522	396	33	26	2.0	2.0	25	33	6.3	6.3

P = poultry litter; P+H = poultry litter plus herbicide; C = control; H = herbicide only; DAP = diammonium phosphate fertilization; DAP+H = diammonium phosphate fertilization plus herbicide.

Table 3—Foliar nutrient status 1 year (2001) and 2 years (2002) after treatment on an old-field loblolly pine stand established in 2000 in Quitman County, GA

Treatment	Nitrogen		Phosphorus		Potassium		Calcium		Magnesium		Sulfur	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
<i>----- percent -----</i>												
P	2.00	1.52	0.16	0.13	0.44	0.46	0.41	0.28	0.05	0.06	0.19b	0.15
P+H	1.93	1.47	0.15	0.14	0.42	0.45	0.44	0.26	0.05	0.05	0.18b	0.15
C	2.11	1.59	0.15	0.13	0.41	0.43	0.33	0.27	0.05	0.05	0.19b	0.15
H	2.00	1.56	0.16	0.12	0.44	0.44	0.37	0.25	0.06	0.05	0.20ab	0.14
DAP	2.21	1.57	0.16	0.12	0.44	0.39	0.36	0.24	0.05	0.05	0.22a	0.15
DAP+H	2.07	1.57	0.16	0.14	0.43	0.45	0.42	0.27	0.05	0.05	0.20ab	0.14

P = poultry litter; P+H = poultry litter plus herbicide; C = control; H = herbicide only; DAP = diammonium phosphate fertilization; DAP+H = diammonium phosphate fertilization plus herbicide.

Table 4—Pretreatment (2000), 1 year (2001), and 2 year (2002) posttreatment growth parameter means in an old-field planted loblolly pine plantation in Quitman County, GA

Treatment	Groundline diameter			Total height			Volume index		
	2000	2001	2002	2000	2001	2002	2000	2001	2002
	----- inches -----						----- cubic inches -----		
P	0.19	0.336b	1.086c	11.3	15.7c	49.4b	0.44	2.05b	66.34c
P+H	0.18	0.455a	1.488a	12.2	17.8ab	63.3a	0.44	4.18	152.20a
C	0.19	0.377b	1.284b	11.7	17.2abc	54.7b	0.44	2.77b	104.81bc
H	0.18	0.492a	1.584a	11.7	18.3a	65.6a	0.40	5.24a	185.63a
DAP	0.18	0.361b	1.276b	11.5	16.3bc	54.8b	0.39	2.54b	103.10bc
DAP+H	0.19	0.494a	1.512a	11.6	18.2a	60.6a	0.43	5.12a	162.48ab
p-value	0.756	< 0.0001	0.0008	0.749	0.035	0.005	0.855	0.0002	0.0025

P = poultry litter, P+H = poultry litter plus herbicide, C = control, H = herbicide only, DAP = diammonium phosphate fertilization, DAP+H = diammonium phosphate fertilization plus herbicide.

significantly greater than the treatments lacking an herbicide component (DAP, poultry litter, and control). Two-year volume index followed the same trend as GLD and total height (table 4). Two-year measurement parameters (GLD, total height, and volume index) results illustrated that there were no statistically significant benefits to adding DAP or poultry litter alone to the microsite around each seedling on this relatively fertile old-field site.

DISCUSSION

These research data suggest that controlling competitive vegetation is more beneficial than spot application of diammonium phosphate or poultry litter to loblolly seedlings at establishment on old-field sites with relatively high fertility. Application of a fertilizer treatment alone appears to increase competing vegetation, and, in this case, significantly decreased seedling early growth. If a landowner chooses to fertilize seedlings at establishment, then controlling the resulting unwanted vegetation must be considered to minimize competition.

The findings from this old-field site using spot application of DAP and poultry litter around seedlings with and without herbicides are different from those reported by Bush and others (1998) and Wilhoit and others (1998) where DAP and poultry litter were broadcast at planting with and without herbicides. Both studies found that loblolly pine early growth was significantly greater with poultry litter and herbicides than herbicides alone or no treatment. Their sites, however, were cutover, and soil nutrient status was likely much lower than the Quitman County, GA, old-field site.

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